

FIG. 1

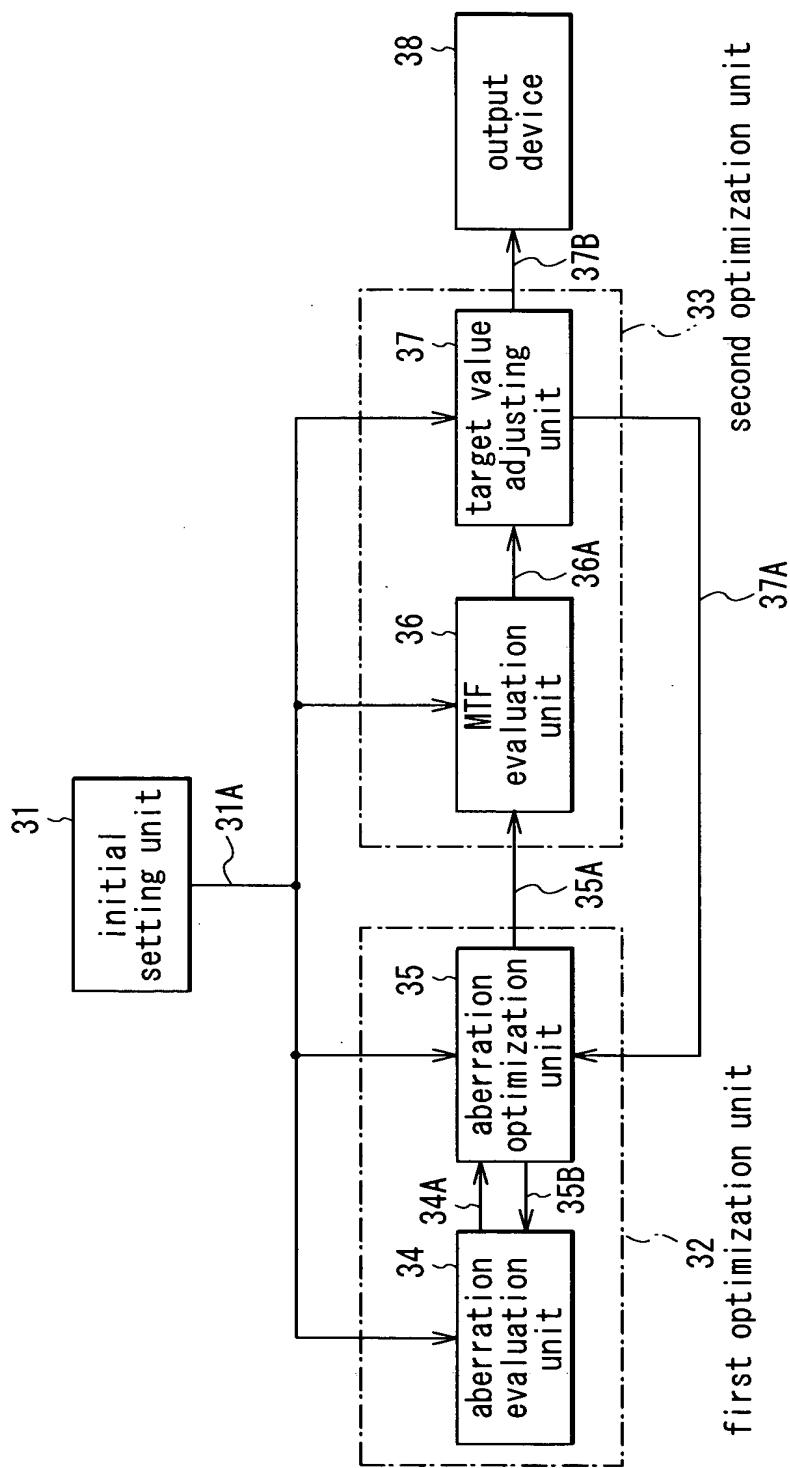


FIG. 2

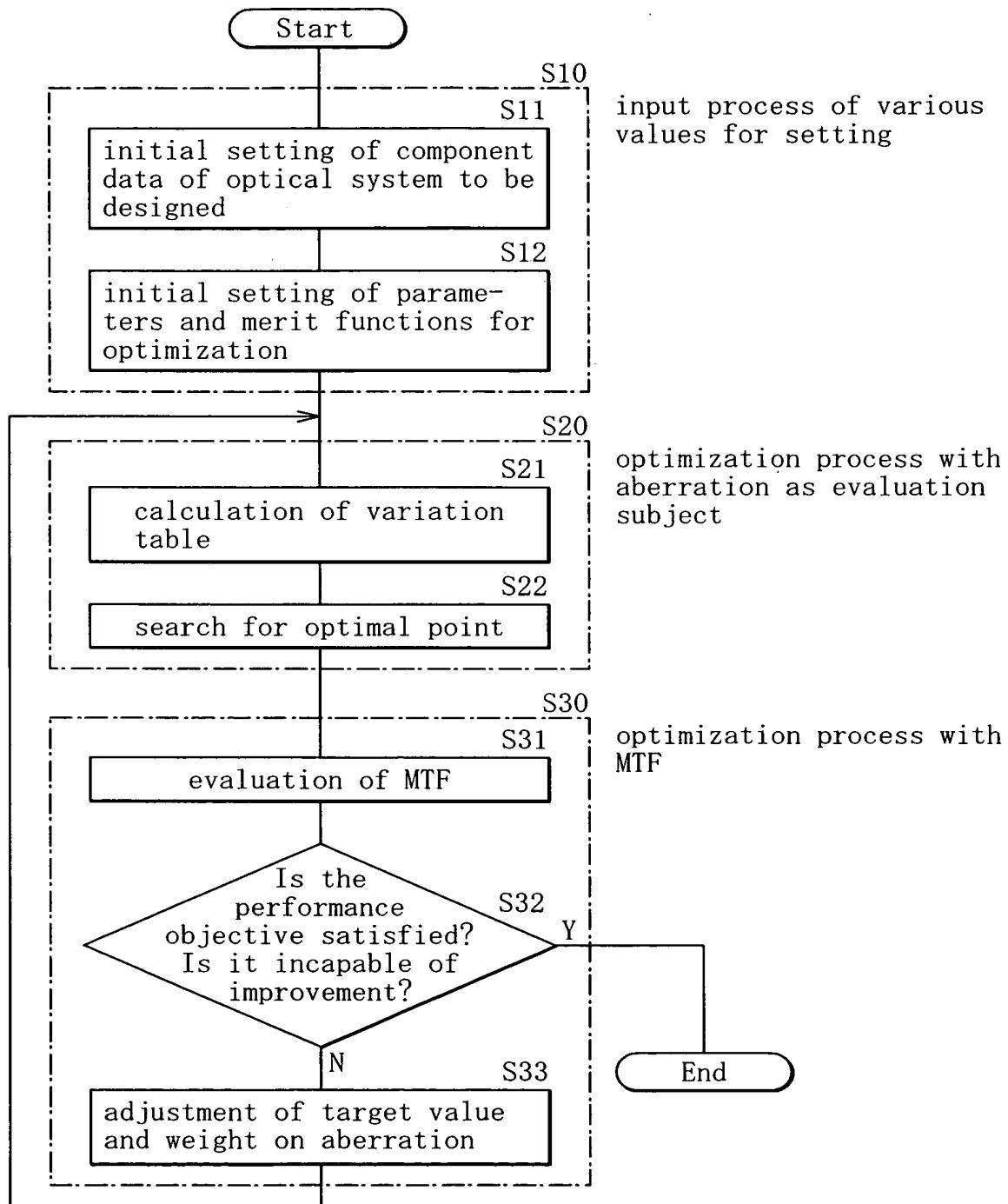


FIG. 3

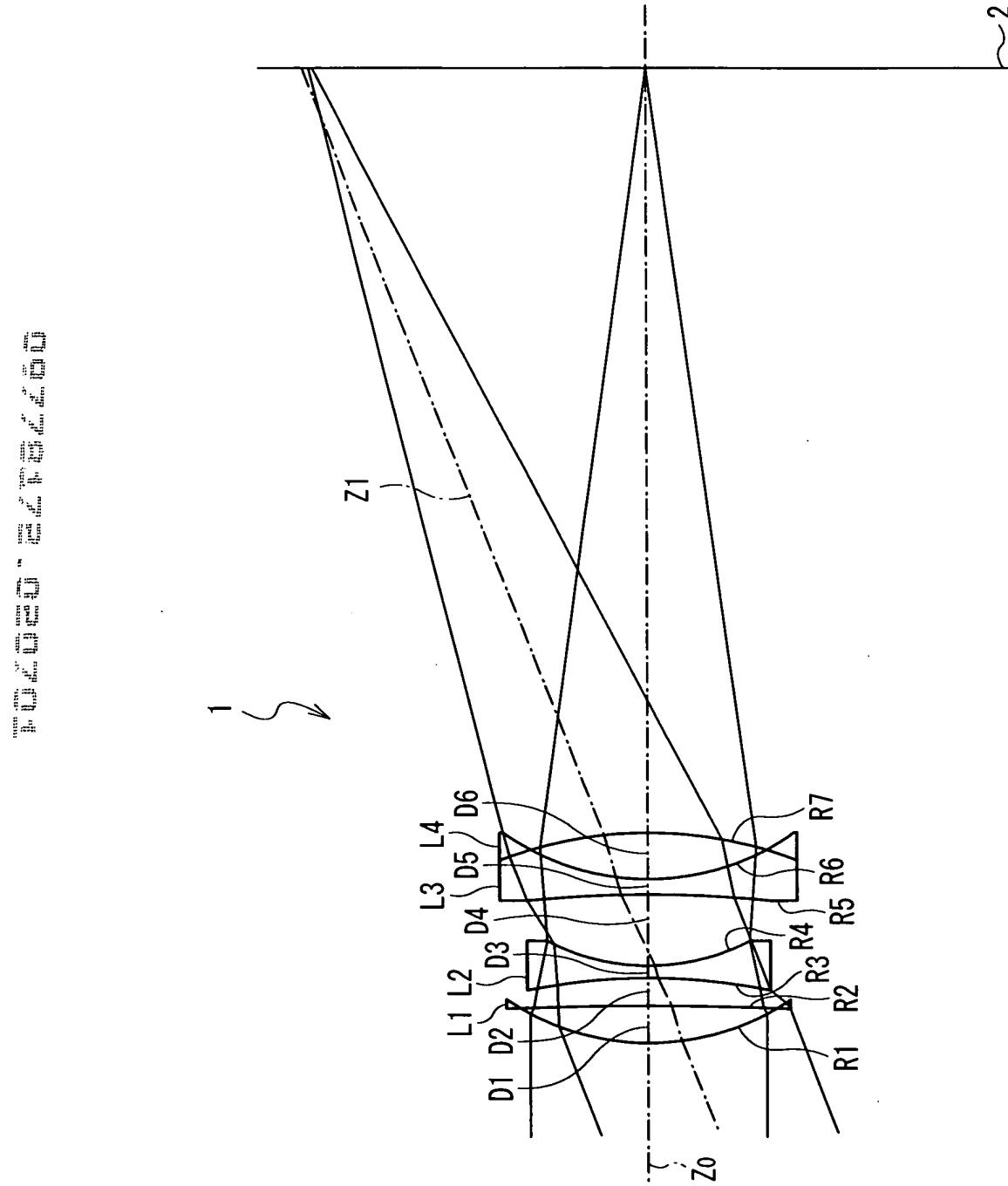


FIG. 4

Lens data at starting point				
S i (Surface No.)	R i (Radius of curvature)	D i (Surface separation)	N d i (Refractive index)	ν d i (Abbe's No.)
1	13.1502	2.0817	1.60800	56.5
2	-128.4561	1.4724		
3	-30.7685	0.8631	1.56000	45.3
4	11.9825	4.0111		
5	-73.1134	0.8631	1.56000	45.3
6	12.6425	2.5894	1.61600	55.0
7	-20.0046	0.0000		

FIG. 5

Design condition	
Focal length f	50mm
Fno.	4.0
Location of object point	infinite
Half field angle ω	20°
Sample object point	center, half field angle of 14° , half field angle of 20°
Evaluation frequency for MTF	40cs/mm
Sample wavelength	435.8nm, 546.1nm, 656.3nm
Weight for wavelength	1 , 1 , 1
Distortion	within 1%
Vignetting	none

FIG. 6

Target value for MTF					
Field angle	Target 1		Target 2		
	S direction	T direction	S direction	T direction	
Center	65%		57%		
	55%	65%	57%	65%	
	55%	65%	57%	65%	

FIG. 7

Result with Target 1						
Field angle	MTF		Adjustment ratio of weight		Target value for mean of longitudinal aberrations (μm)	
	S direction	T direction	S direction	T direction	S direction	T direction
Center	64%		1.2		13.6	
	55%	64%	1.5	1.1	11.7	-12.4
	54%	64%	0.7	1.8	-11.6	-34.2

FIG. 8

Result with Target 2						
Field angle	MTF		Adjutment ratio of weight		Target value for mean of longitudinal aberrations (μm)	
	S direction	T direction	S direction	T direction	S direction	T direction
Center	56%		1.0		15.3	
	57%	65%	1.5	0.9	16.0	-10.7
	57%	64%	0.8	1.5	-10.8	-34.0

FIG. 9

Lens data of solution with Target 1				
S i (Surface No.)	R i (Radius of curvature)	D i (Surface separation)	N d i (Refractive index)	v d i (Abbe's No.)
1	18. 9178	5. 9592	1. 79080	48. 9
2	48. 4813	2. 0454		
3	-56. 2882	2. 0000	1. 66405	32. 6
4	17. 1377	2. 3758		
5	120. 5964	2. 0710	1. 57937	40. 1
6	20. 0136	3. 8850	1. 80000	48. 0
7	-34. 3802	0. 0000		

FIG. 10

Lens data of solution with Target 2				
S i (Surface No.)	R i (Radius of curvature)	D i (Surface separation)	N d i (Refractive index)	v d i (Abbe's No.)
1	18. 4608	4. 5462	1. 80000	48. 0
2	59. 1162	2. 3640		
3	-69. 4418	2. 0000	1. 67159	32. 1
4	16. 3997	2. 8414		
5	294. 9039	2. 2763	1. 57555	40. 8
6	20. 8082	3. 9552	1. 80000	48. 0
7	-35. 6773	0. 0000		

FIG. 11

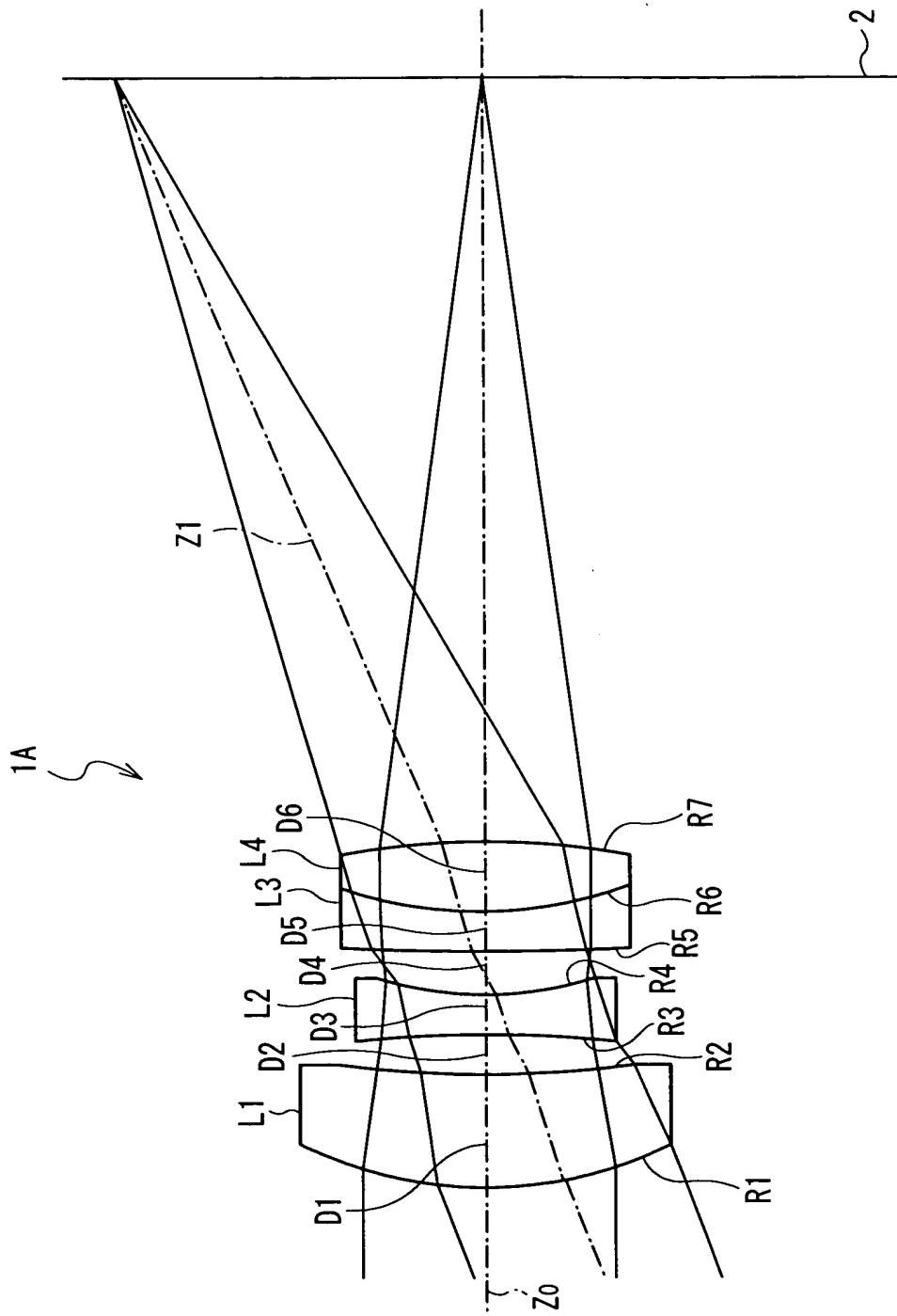


FIG. 12

9 / 24

1B
Z1
Z0
R1
R2
R3
R4
R5
R6
R7
D1
D2
D3
D4
D5
D6
L1
L2
L3
L4

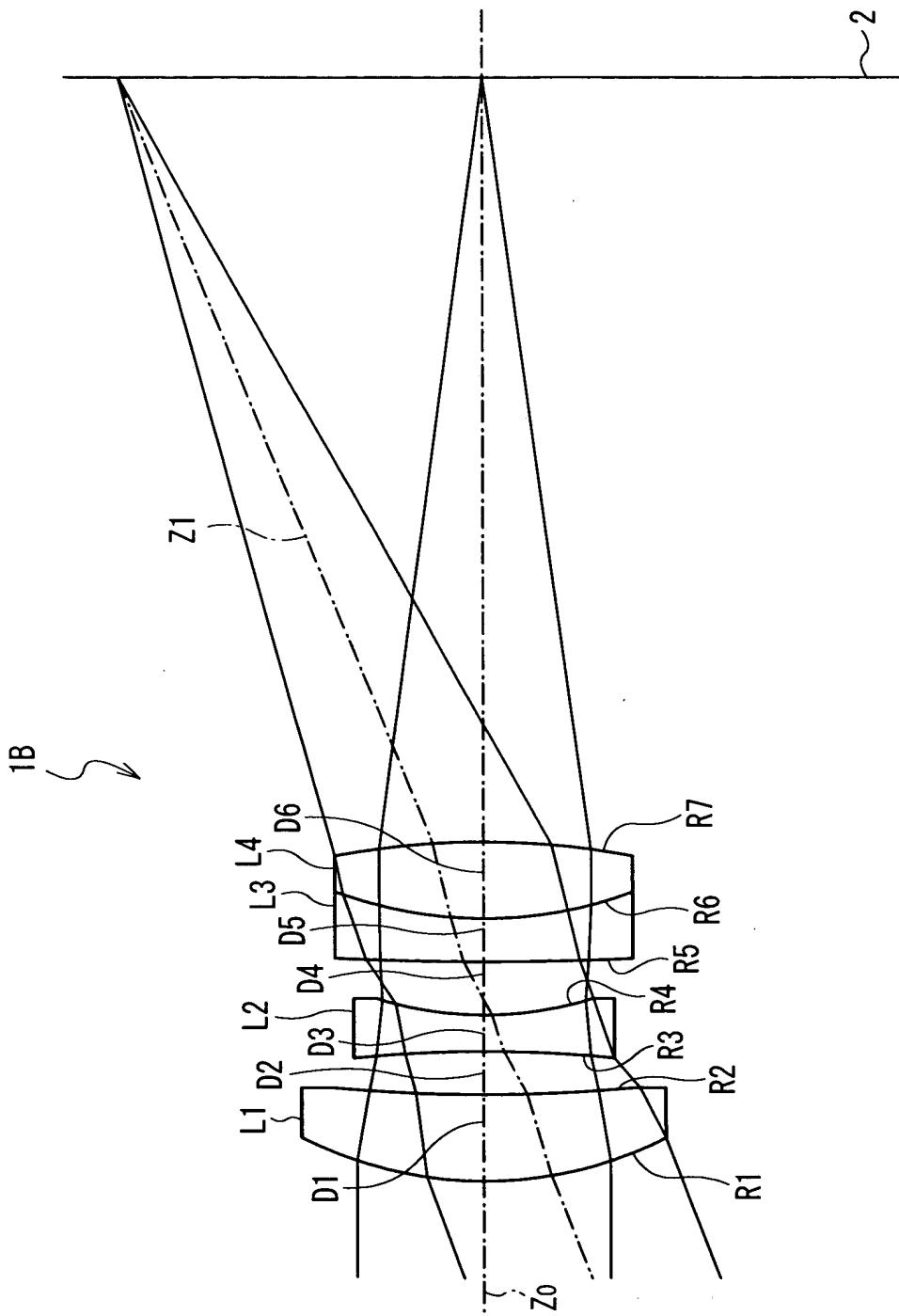


FIG. 13

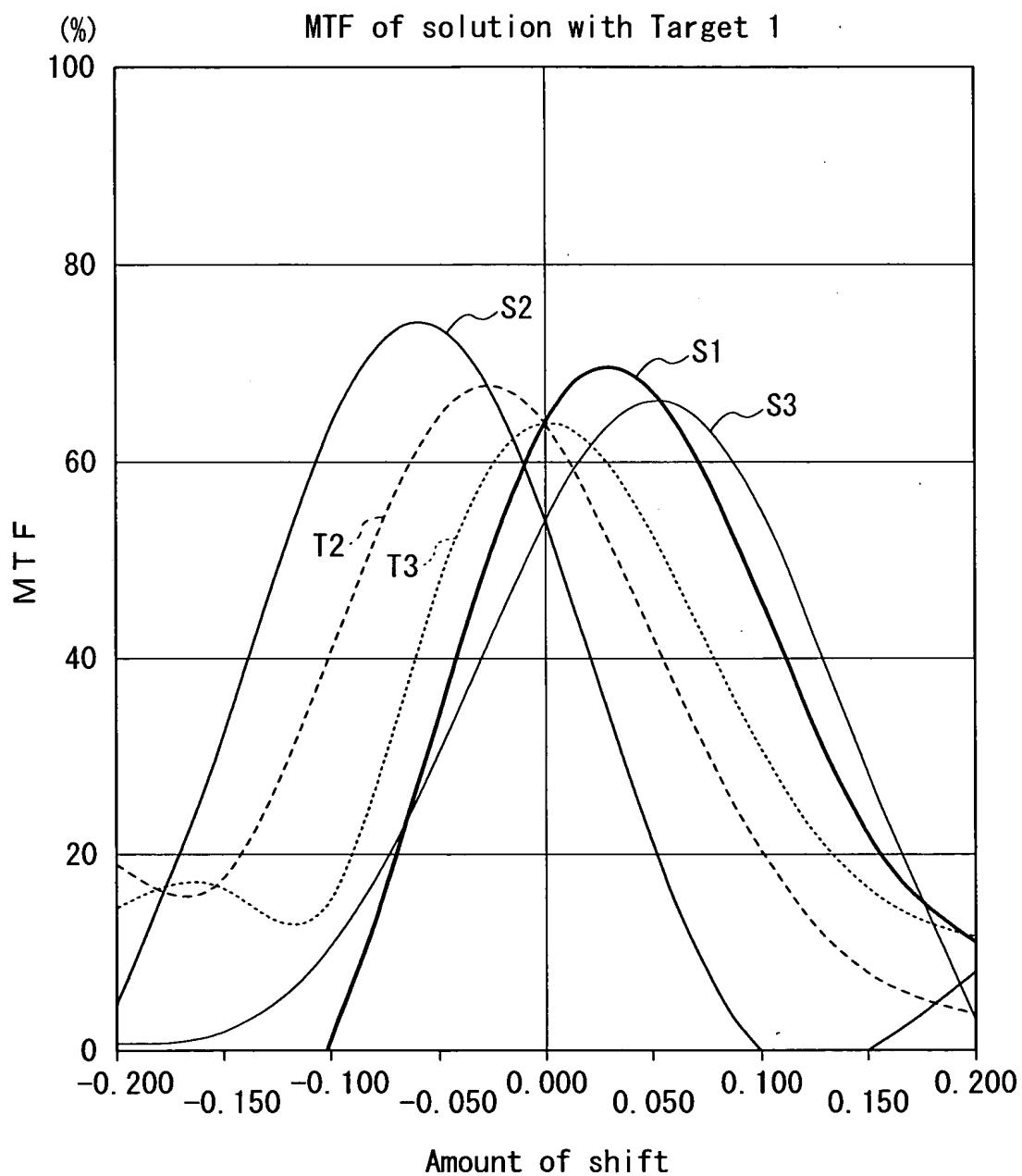


FIG. 14

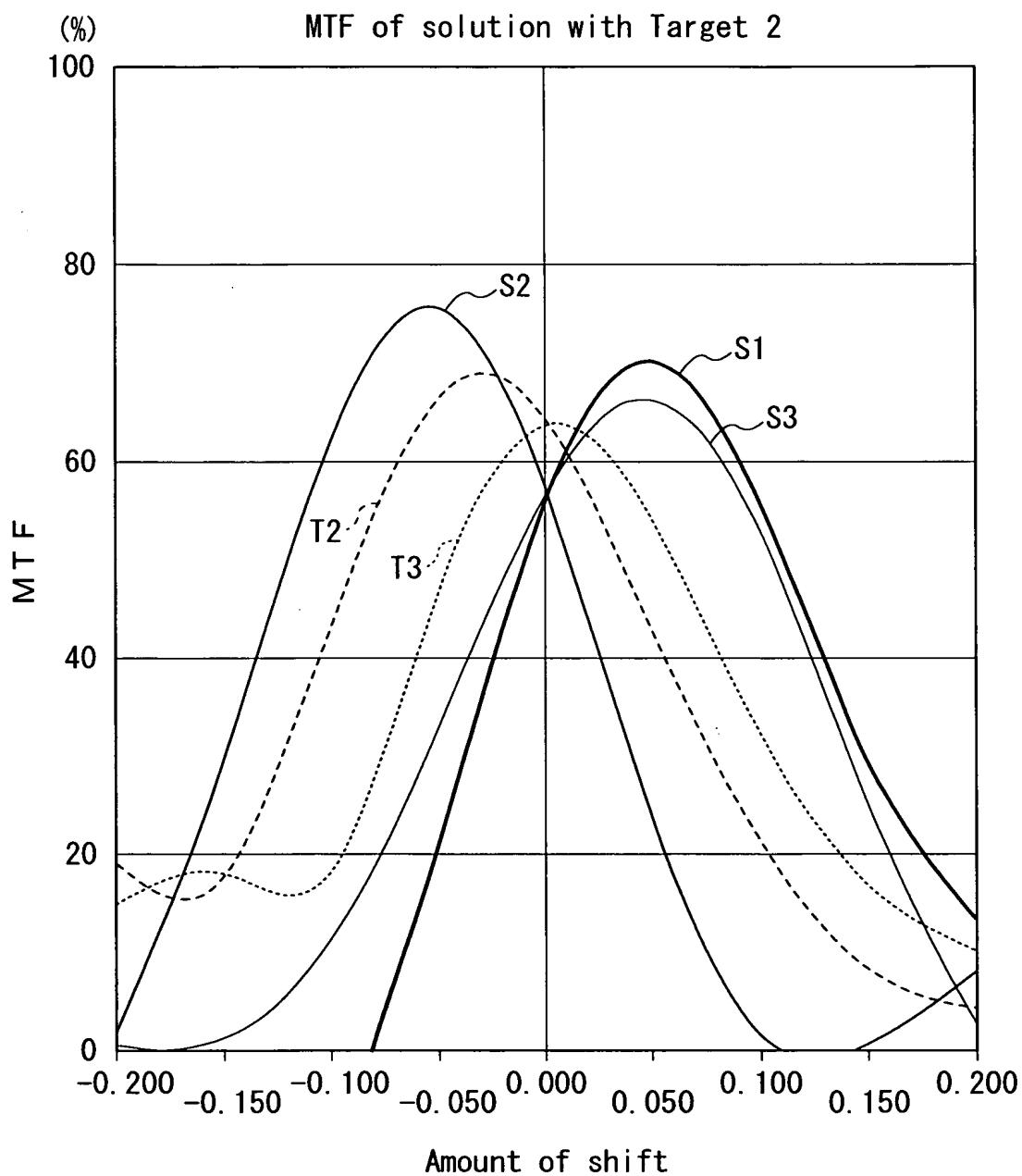


FIG. 15

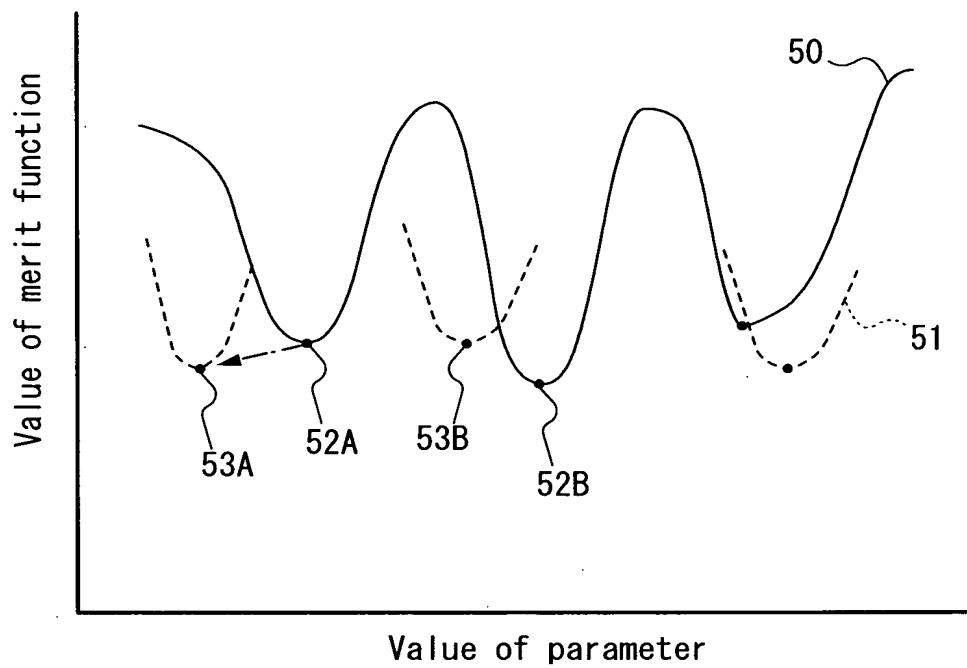


FIG. 16

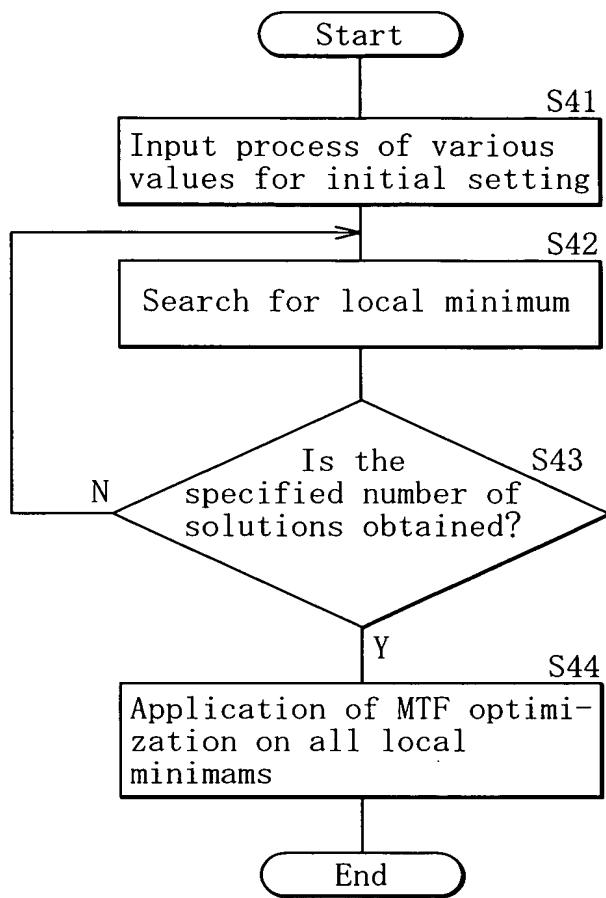


FIG. 17

Target value for MTF		
Field angle	Target	
	S direction	T direction
Center	65%	
	55%	65%
	60%	65%

FIG. 18

Solution No.	Value of merit function	
	Aberration	M T F
1	0.001598	10. 3%
2	0.001543	10. 7%
3	0.001539	2. 7%
4	0.001549	7. 7%
5	0.001539	6. 5%

FIG. 19

Lens data of solution No.3				
S i (Surface No.)	R i (Radius of curvature)	D i (Surface separation)	N d i (Refractive index)	v d i (Abbe's No.)
1	19. 8762	5. 4071	1. 80000	43. 8
2	-282. 4339	1. 6230		
3	-43. 4813	2. 0000	1. 72558	30. 2
4	16. 8887	3. 6591		
5	-127. 0678	2. 0000	1. 67193	44. 0
6	19. 2644	5. 2366	1. 80000	48. 0
7	-28. 2142	0. 0000		

FIG. 20

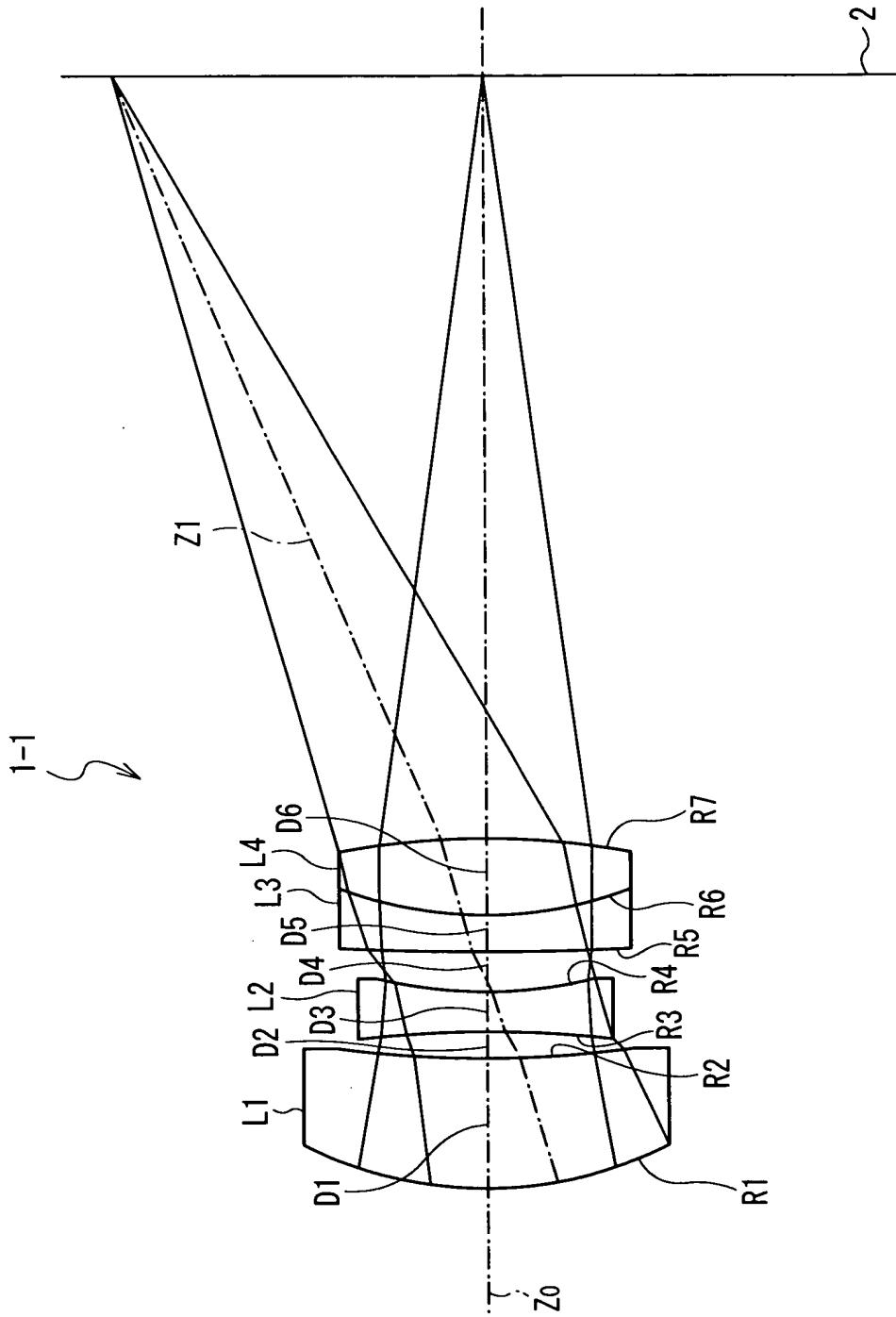


FIG. 21

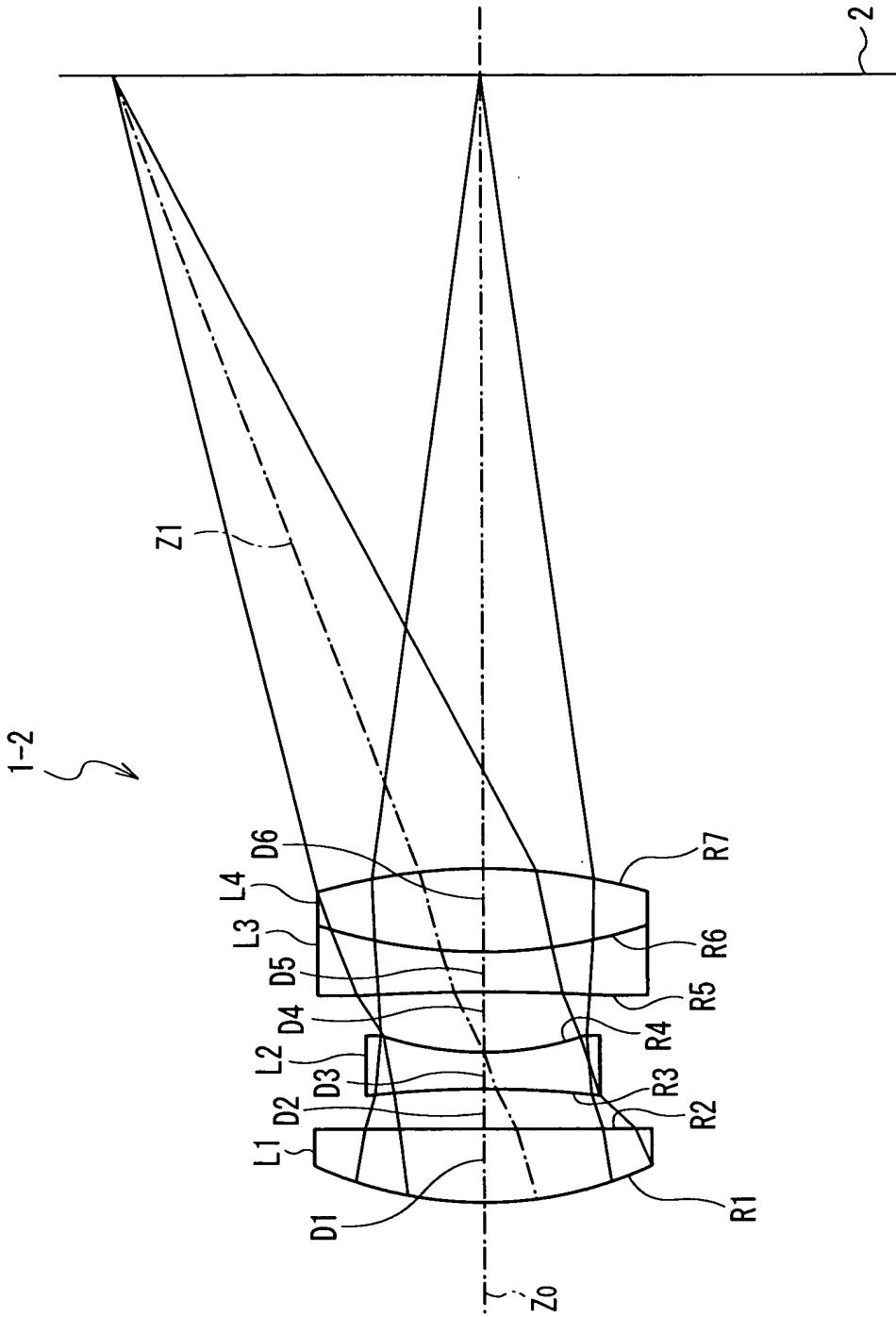


FIG. 22

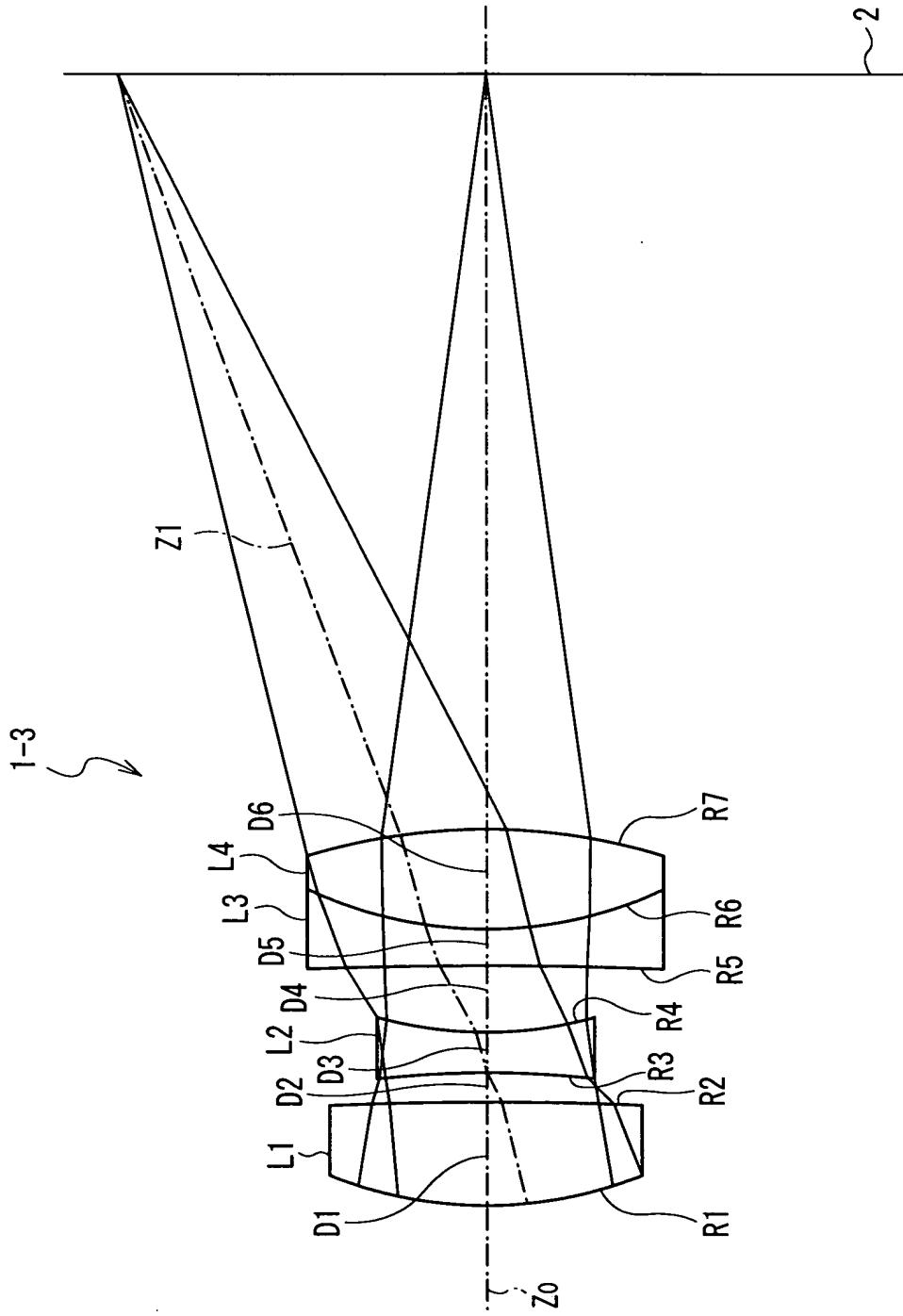
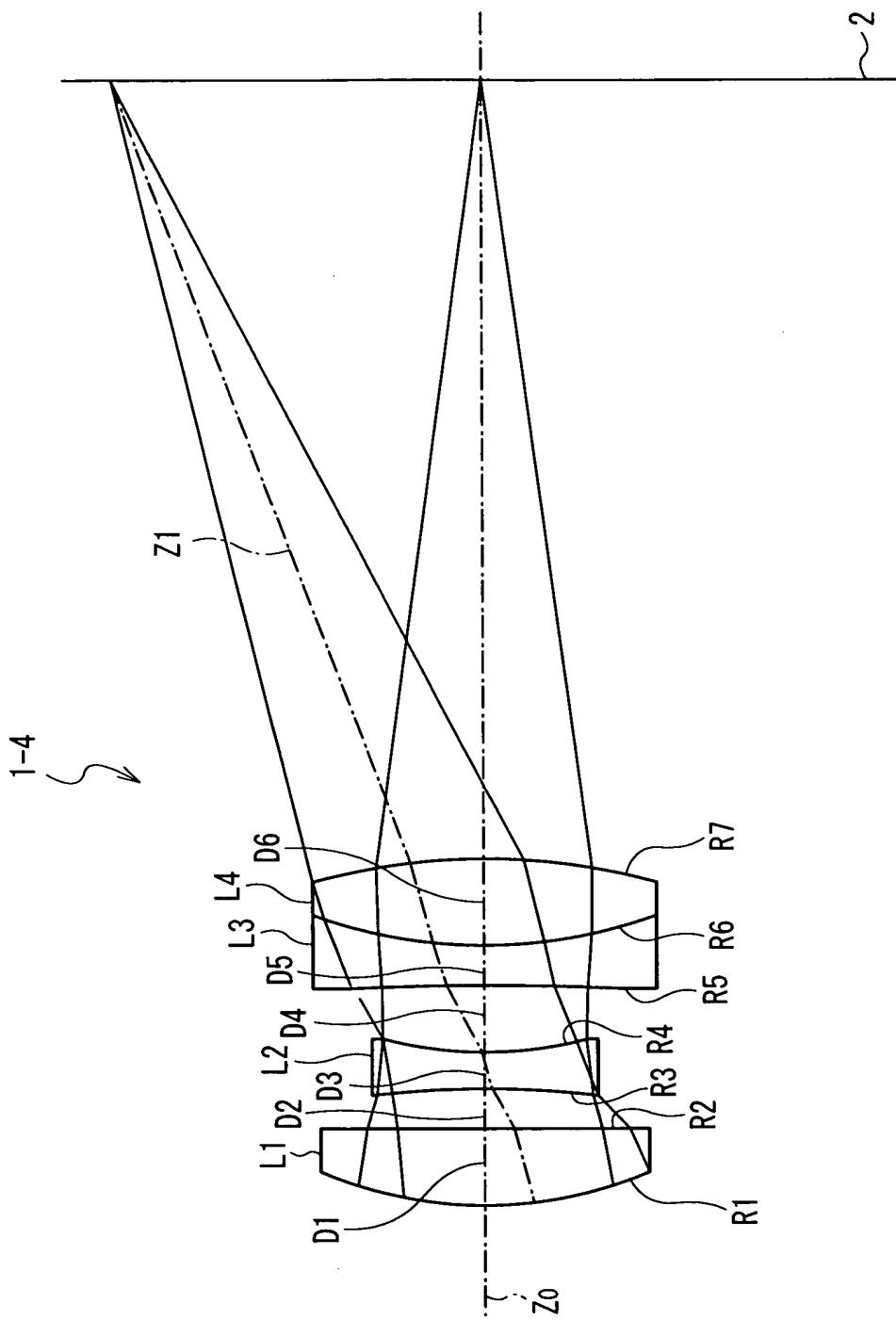


FIG. 23



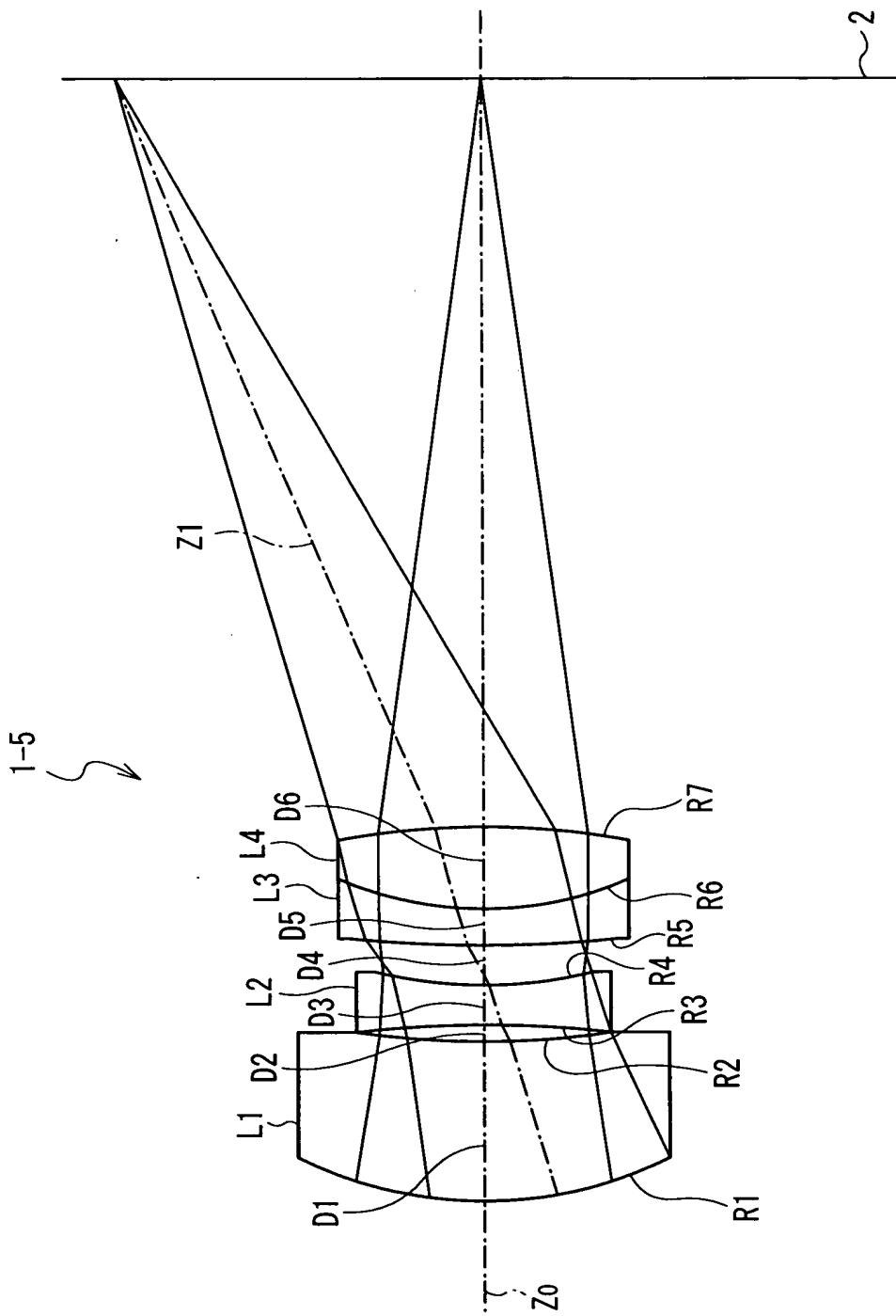


FIG. 25

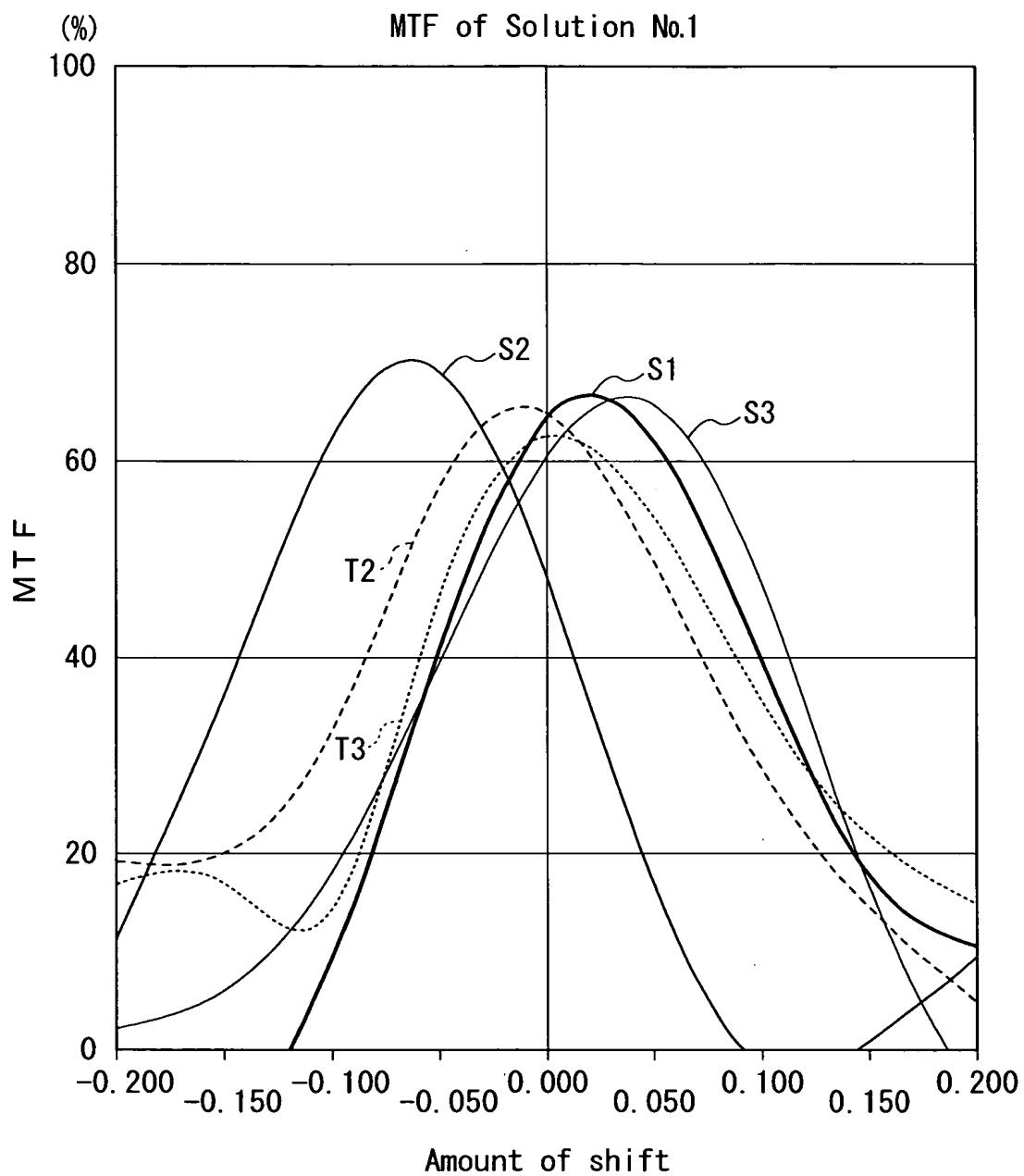


FIG. 26

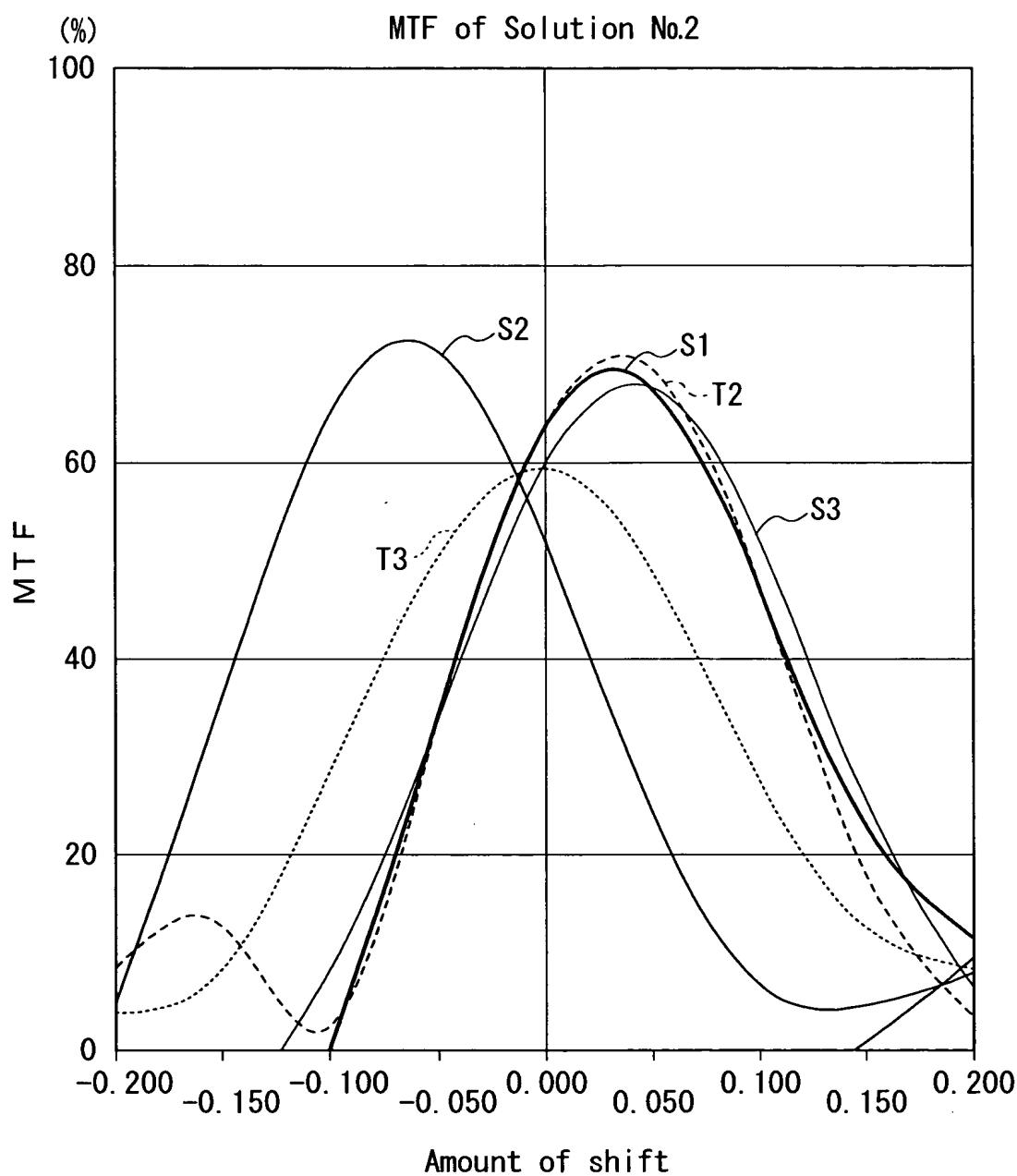


FIG. 27

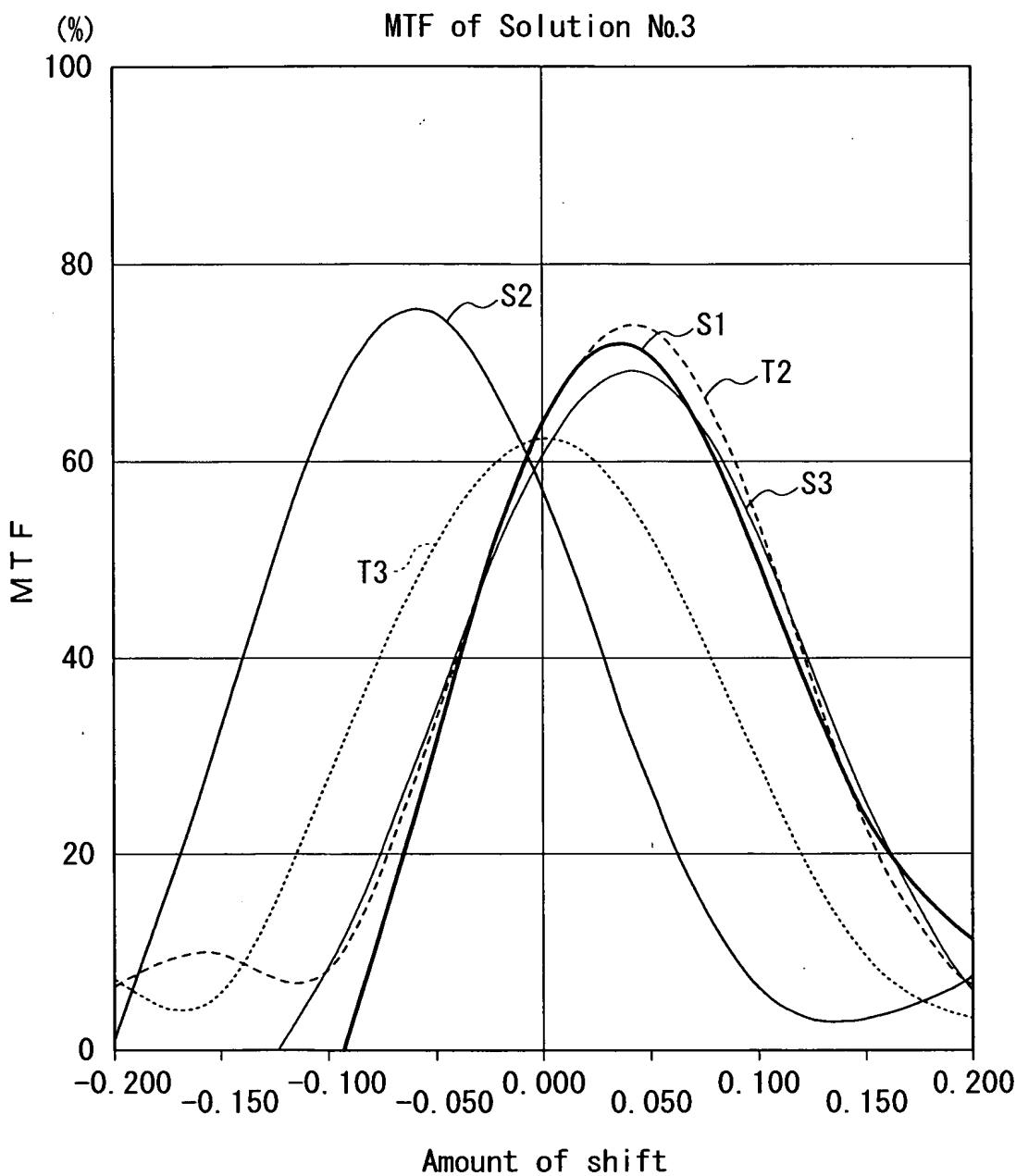


FIG. 28

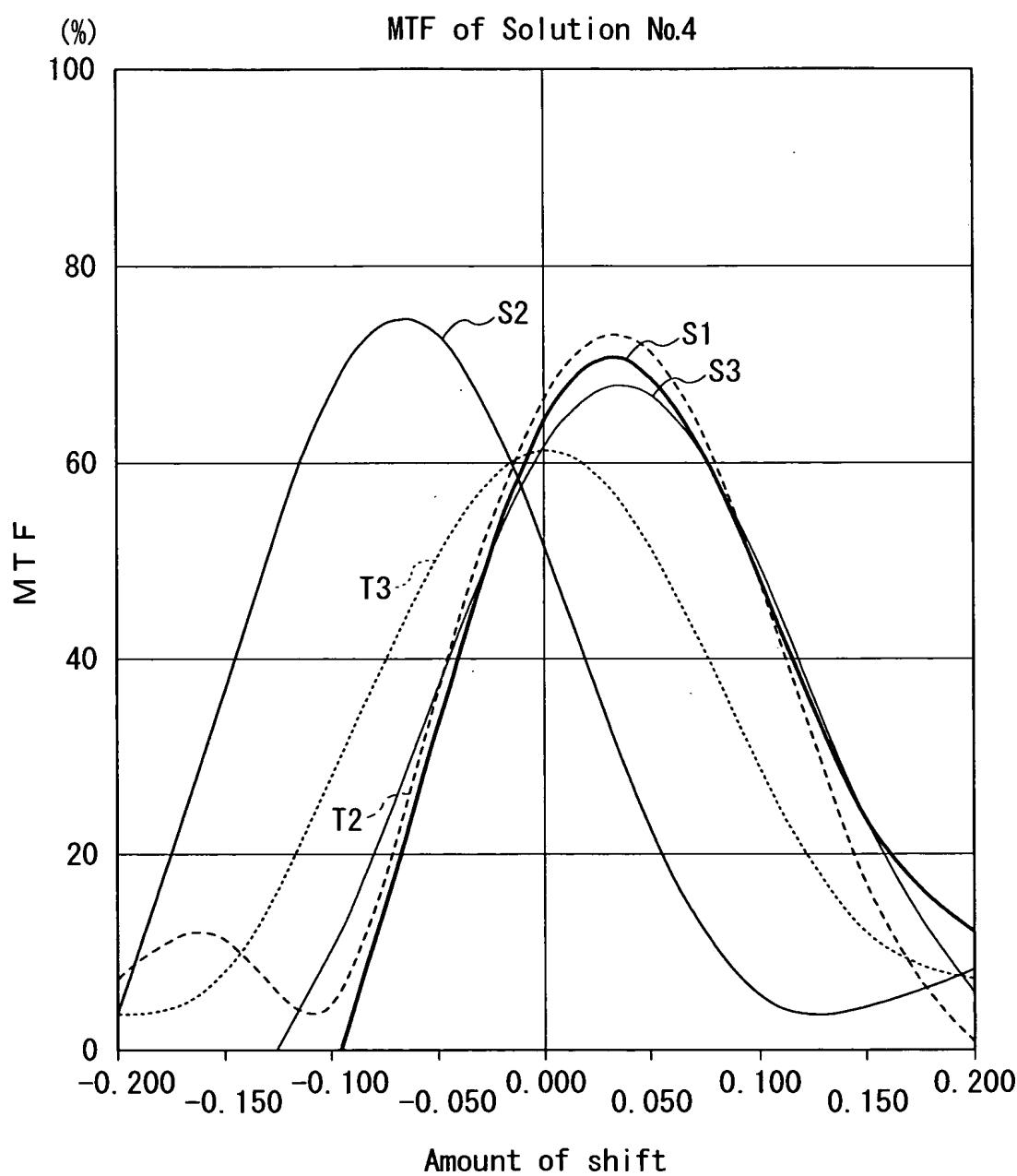


FIG. 29

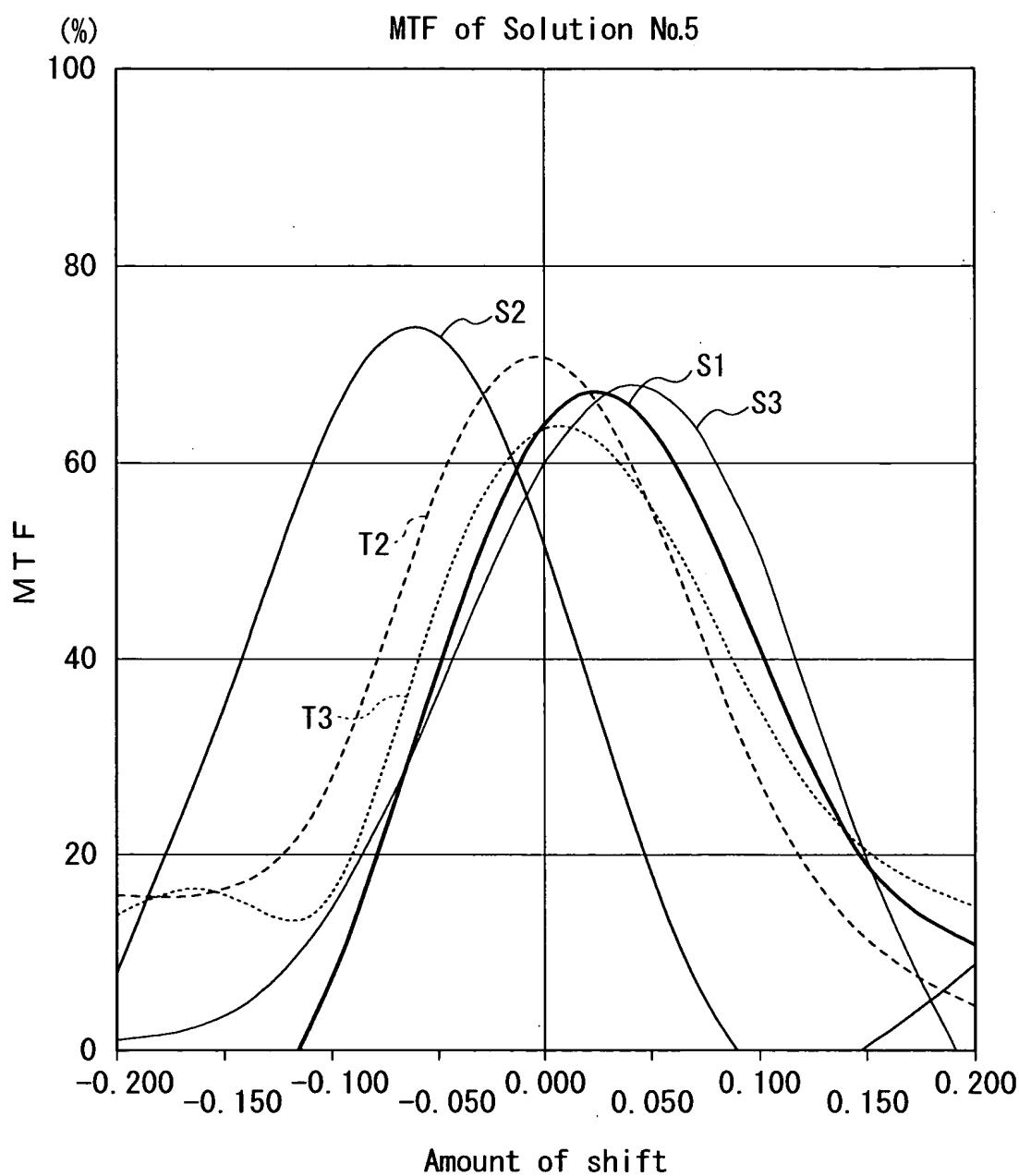


FIG. 30